

MSC-23153-1

CLAIMS

What is claimed is:

What is claimed is:

- 1 1. An instrument for detecting one or more superstrates, comprising:
2 a transmission line;
3 a substrate mounted on an opposite side of said transmission line from said one or
4 more superstrates;
5 a plurality of measurement cells formed within said transmission line;
6 a microwave source for applying a microwave signal to said transmission line and
7 each of said plurality of measurement cells formed within said transmission line; and
8 a detector for detecting said one or more superstrates with respect to said plurality
9 of measurement cells.

- 1 2. The instrument of Claim 1, wherein said transmission line further comprises a
2 coplanar waveguide with a center conductor mounted between two outer conductors.

1

MSC-23153-1

1 3. The instrument of Claim 2, wherein said center conductor is mounted so as to
2 define first and second spaces between said center conductor and each of said two outer
3 conductors, said first and second spaces each having a width smaller than about one
4 hundredth of an inch.

1 4. The instrument of Claim 3, wherein said first and second spaces are equal in
2 width.

1 5. The instrument of Claim 3, wherein said center conductor is mounted so as to
2 define first and second spaces between said center conductor and each of said two outer
3 conductors, said first and second spaces each having a width such that an electric field is
4 affected by said one or more superstrates having a thickness of less than two millimeters.

1 6. The instrument of Claim 1, wherein said substrate has a thickness of less than one
2 tenth inch.

1 7. The instrument of Claim 1, wherein said substrate has a dielectric constant less
2 than five.

MSC-23153-1

1 8. The instrument of Claim 1, further comprising a coaxial cable connected to said
2 transmission line with a gold ribbon connection.

1 9. The instrument of Claim 1, further comprising:
2 each of said plurality of measurement cells being spaced apart along said
3 transmission line with respect to each other.

1 10. The instrument of Claim 1, further comprising:
2 a known superstrate for covering a plurality of non-measurement portions of said
3 transmission line not including said measurement cells.

1 11. The instrument of Claim 10, wherein each of said plurality of non-measurement
2 portions of said transmission line have a length equal to an effective wavelength of said
3 microwave signal divided by two.

1 12. The instrument of Claim 1, further comprising a plurality of non-measurement
2 portions of said transmission line, at least a portion of said measurement cells being
3 physically partitioned from said plurality of non-measurement portions of said
4 transmission line.

MSC-23153-1

1 13. The instrument of Claim 1, further comprising a plurality of non-measurement
2 portions of said transmission line, at least a portion of said measurement cells being non-
3 physically partitioned from said plurality of non-measurement portions of said
4 transmission line.

1 14. The instrument of Claim 1, further comprising:
2 a plurality of transmission lines, a plurality of measurement cells formed on each
3 of said plurality of transmission lines, and a multiplexor for switching between said
4 plurality of transmission lines.

1 15. The instrument of Claim 1, wherein at least one of said one or more superstrates is
2 formed of a porous material.

1 16. The instrument of Claim 1, wherein at least a portion of said substrate is formed
2 of a porous material.

1 17. The instrument of Claim 1, wherein said transmission line is uniform along its
2 length without discontinuities.

MSC-23153-1

1 18. The instrument of Claim 1, further comprising:

2 a plurality of discontinuities formed within said transmission line.

1 19. The instrument of Claim 18, wherein said plurality of discontinuities further

2 comprise a plurality of stubs extending from said transmission line.

1 20. The instrument of Claim 19, wherein said plurality of stubs form said plurality of

2 measurement cells.

1 21. The instrument of Claim 19, wherein said plurality of stubs form markers between

2 said plurality of measurement cells.

1 22. The instrument of Claim 18, wherein said plurality of discontinuities further

2 comprises a plurality of power dividers.

MSC-23153-1

1 23. The instrument of Claim 1, further comprising:

2 a second transmission line, said second transmission line being configured to
3 produce a detected signal more sensitive to a thickness of said one or more superstrates
4 than said first transmission line.

1 24. The instrument of Claim 1, wherein said transmission line is configured to

2 provide a signal to said detector that is substantially unaffected by a thickness of said one
3 or more superstrates.

1 25. A waveguide sensor for detecting one or more superstrates, comprising:

2 a center conductor;

3 two outer conductors mounted such that said center conductor is disposed
4 between said two outer conductors such that a respective spacing is formed on either side
5 said center conductor separating said center conductor from said two outer conductors,
6 each said respective spacing being selected for controlling a measurement depth of said
7 superstrate, said center conductor and said two outer conductors being oriented parallel
8 with respect to each other; and

9 a substrate mounted on an opposite side of said waveguide sensor from said
10 superstrate.

MSC-23153-1

1 26. The waveguide sensor of Claim 25, wherein each of said respective spacings are
2 less than one-hundreth of an inch.

1 27. The waveguide sensor of Claim 25, wherein each of said respective spacings are
2 selected for detecting a superstrate less than two millimeters thick.

1 28. The waveguide sensor of Claim 25, wherein said substrate has a dielectric
2 constant less than about five.

1 29. The waveguide sensor of Claim 25, wherein said substrate has a thickness less
2 than about one-tenth of an inch.

1 30. The waveguide sensor of Claim 25, wherein at least a portion of said substrate is
2 porous.

1 31. The waveguide sensor of Claim 25, further comprising:
2 a plurality of measurement cells disposed along said center conductor and said
3 two outer conductors.

MSC-23153-1

1 32. The waveguide sensor of Claim 31, further comprising:
2 a plurality of non-measurement portions disposed along said center conductor
3 and said two outer conductors, at least a portion of said plurality of measurement cells
4 being physically partitioned from said plurality of non-measurement portions.

1 33. The waveguide sensor of Claim 31, further comprising:
1 a plurality of non-measurement portions disposed along said center conductor and
2 said two outer conductors, at least a portion of said measurement cells being non-
3 physically partitioned from said plurality of non-measurement portions.

1 34. The waveguide sensor of Claim 31, further comprising:
2 a plurality of non-measurement portions disposed along said center conductor
3 and said two outer conductors, a microwave source for applying a microwave signal to
4 each of said plurality of measurement cells, said non-measurement portions having a
5 length of a wavelength of said microwave signal divided by two, and a known superstrate
6 covering said center conductor for said plurality of non-measurement portions.

MSC-23153-1

1 35. The waveguide sensor of Claim 25, wherein each said respective spacing is equal
2 to each other.

1 36. The waveguide sensor of Claim 25, further comprising:
2 a second waveguide for determining a thickness of said superstrate, said second
3 waveguide having a single elongate conductive strip, a conductive ground plane, and a
4 second substrate separating said elongate conductive strip and said conductive ground
5 plane.

1 37. A waveguide sensor for detecting one or more superstrates, comprising:
2 a single elongate conductive strip;
3 a conductive ground plane; and
4 a substrate mounted on an opposite side of said one or more superstrates, said
5 substrate separating said single elongate conductive strip and said conductive ground
6 plane.

1 38. The waveguide sensor of Claim 37, further comprising:
2 said substrate being selected for sensing a thickness of said superstrate up to about

MSC-23153-1

3 one inch, and
4 a second waveguide, said second waveguide comprising a center conductor and
5 two outer conductors mounted such that said center conductor is disposed between said
6 two outer conductors forming a space on either side of said center conductor, said
7 spacing being selected such that a signal produced by said second waveguide is
8 substantially insensitive to said thickness of said superstrate.

1 39. The waveguide sensor of Claim 37, wherein said substrate has a thickness in the
2 range of from 0.075 inches to 0.150 inches.

1 40. The waveguide sensor of Claim 37, wherein said substrate has a dielectric
2 constant less than about five.

1 41. The waveguide sensor of Claim 37, wherein at least a portion of said substrate is
2 porous.
3

1 42. The waveguide sensor of Claim 37, further comprising:
2 a plurality of measurement cells disposed along said single conductive strip.

1 43. The waveguide sensor of Claim 42, further comprising:
2 a plurality of non-measurement portions disposed along said single conductive
3 strip, at least a portion of said measurement cells being physically partitioned from said
4 plurality of non-measurement portions.

1 44. The waveguide sensor of Claim 42, further comprising:
1 a plurality of non-measurement portions disposed along said elongate conductive
2 strip, at least a portion of said measurement cells being non-physically partitioned from
3 said plurality of non-measurement portions.

1 45. The waveguide sensor of Claim 42, further comprising:
2 a plurality of non-measurement portions disposed along said single conductive
3 strip, a microwave source for applying a microwave signal to each of said plurality of
4 measurement cells, at least a portion of said non-measurement portions having a length
5 of a wavelength of said microwave signal divided by two, and a known superstrate
6 covering said plurality of non-measurement portions.

MSC-23153-1

1 46. A computer simulation for predicting results of a simulated superstrate detector,
2 said simulated superstrate detector having a transmission line with a plurality of sensors
3 along said transmission line, said computer simulation comprising:
4 a first input for a transmission line substrate thickness;
5 a second input for a transmission line substrate dielectric constant;
6 a third input for producing a change related to a simulated superstrate;
7 a fourth input for an operating frequency; and
8 an output for said simulated superstrate detector.

1 47. The computer simulation of Claim 46, wherein said third input relates to
2 temperature change for said simulated superstrate.

1 48. The computer simulation of Claim 47, further comprising:
2 an input for starting temperature.

MSC-23153-1

1 49. The computer simulation of Claim 46, further comprising:
2 an input for changes in temperature.

1 50. The computer simulation of Claim 46, wherein possible superstrates to be
2 detected are defined.

1 51. The computer simulation of Claim 50, wherein possible superstrates are limited to
2 air, water, ice, glycol and mixtures of water, ice, and glycol.

1 52. The computer simulation of Claim 46, further comprising:
2 a fifth input for a size of each of said plurality of sensors.

1 53. A method of detecting one or more superstrates on a transmission line,
2 comprising:
3 providing a plurality of measurement cells within said transmission line;
4 applying a signal to said transmission line such that said signal is applied to each
5 of said measurement cells;

MSC-23153-1

6 measuring an output signal from said transmission line for said detection of said
7 one or more superstrates.

1 54. The method of Claim 53, further comprising:
2 measuring a phase of said output signal.

1 55. The method of Claim 53, further comprising:
2 measuring a phase and amplitude of said output signal.

1 56. The method of Claim 53, further comprising:
2 providing a plurality of transmission lines wherein each of said plurality of
3 transmission lines contains a plurality of measurement cells.

1 57. The method of Claim 56, further comprising:
2 providing a multiplexor to separately sample a respective output signal from each
3 of said plurality of transmission lines.

MSC-23153-1

1 58. The method of Claim 56, further comprising:
2 utilizing said plurality of transmission lines to determine a position of said one or
3 more superstrates.

1 59. The method of Claim 58, further comprising:
2 positioning said plurality of measurement cells on each of said plurality of
3 transmission lines to enhance said determining of said position of said one or more
4 superstrates.

1 60. The method of Claim 59, further comprising:
2 staggering a first of said plurality of measurement cells on a first of said plurality
3 of transmission lines with respect to a second of said plurality of measurement cells on a
4 second of said plurality of transmission lines.

1 61. The method of Claim 58, further comprising:
2 providing different lengths for said plurality of transmission lines.
3

MSC-23153-1

3

1 62. The method of Claim 56, further comprising:
2 utilizing different frequencies on said plurality of transmission lines.

1 63. The method of Claim 56, further comprising:
2 utilizing a first transmission line for detecting a presence of one or more
3 superstrates, and
4 utilizing a second transmission line for detecting a thickness of said one or more
5 superstrates when said presence is detected.

1 64. The method of Claim 53, further comprising:
2 collecting data with a data acquisition board.

MSC-23153-1

1 65. The method of Claim 53, wherein said signal is a microwave signal.

1 66. A method of determining a respective complex constant associated with one or
2 more superstrates positioned along a waveguide at a plurality of measurement positions,
3 said method comprising:

4 applying a plurality of frequencies to said waveguide;

5 measuring an amplitude and phase for each of said plurality of frequencies to

6 produce an observed data vector; and

7 estimating a complex constant for said one or more measurement positions to

8 produce an estimated data vector.

1 67. The method of Claim 66, further comprising:

2 providing that characteristic impedance and propagation constants of said

3 waveguide are known when said wave guide is covered by said one or more superstrates.

1 68. The method of Claim 66, further comprising:

2 comparing said observed data vector with said estimated data vector to produce a

3 difference data vector.

MSC-23153-1

1 69. The method of Claim 66, further comprising:
2 reiterating said steps of estimating and comparing until said difference data vector
3 approaches zero; and
4 determining a final estimated complex constant for each of said one or more
5 superstrates.

1 70. The method of Claim 66, further comprising:
1 constraining values of said estimated complex constant for each of said one or
2 more measurement positions to discrete values associated with one or more anticipated
3 superstrates.

1 71. The method of Claim 66, further comprising;
2 comparing a change of said observed data vector with a known rate of change.

1 72. The method of Claim 71, wherein said known rate of change is from water to ice.

1 73. The method of Claim 71, wherein said known rate change is from ice to air due to
2 a strong wind event.

MSC-23153-1

1 74. The method of Claim 69, further comprising:
2 when said complex constant for each of said one or more measurement positions
3 are slowly changing then optimizing said method using said final estimated complex
4 constant for each of said one or more superstrates as a first iteration estimated complex
5 constant for each of said one or more superstrates.

1 75. The method of Claim 66, wherein said step of estimating further comprises
2 estimating a complex dielectric constant for each of said one or more measurement
3 positions to produce said estimated data vector.

1 76. An ice detector operable for use on a surface that may be covered with ice, said
2 ice detector comprising:

3 one or more elongate transmission lines greater than ten feet long, said one or
4 more transmission line having a thickness less than about one-tenth of an inch so as to
5 substantially conform to said surface;

6 one or more metallic covered measuring cells along said one or more elongate
7 transmission lines;

8 a microwave signal source for exciting said one or more elongate transmission

MSC-23153-1

9 lines;
10 a detector for receiving a signal from said one or more elongate transmission
11 lines; and
12 a processor for processing said signal from said one or more elongate
13 transmission lines.

1 77. The ice detector of Claim 76, further comprising:
2 a plurality of said measuring cells and a plurality of non-measuring cells forming
3 said one or more elongate transmission lines.

1 78. The ice detector of Claim 77, wherein said microwave frequency may be varied
2 for changing a relative electrical spacing of said plurality of said measuring cells and said
3 plurality of said non-measuring cells.

1 79. The ice detector of Claim 76, wherein said microwave signal source produces a
2 plurality of frequencies.

1 80. The ice detector of Claim 76, wherein said processor obtains a time domain response
2 by a Fourier transform of said signal.

Express Mailing Certificate No. EF775095726US
Patent Application

68729	68730	68731	68732	68733
68734	68735	68736	68737	68738
68739	68740	68741	68742	68743
68744	68745	68746	68747	68748
68749	68750	68751	68752	68753
68754	68755	68756	68757	68758
68759	68760	68761	68762	68763
68764	68765	68766	68767	68768
68769	68770	68771	68772	68773
68774	68775	68776	68777	68778
68779	68780	68781	68782	68783
68784	68785	68786	68787	68788
68789	68790	68791	68792	68793
68794	68795	68796	68797	68798
68799	68800	68801	68802	68803
68804	68805	68806	68807	68808
68809	68810	68811	68812	68813
68814	68815	68816	68817	68818
68819	68820	68821	68822	68823
68824	68825	68826	68827	68828
68829	68830	68831	68832	68833
68834	68835	68836	68837	68838
68839	68840	68841	68842	68843
68844	68845	68846	68847	68848
68849	68850	68851	68852	68853
68854	68855	68856	68857	68858
68859	68860	68861	68862	68863
68864	68865	68866	68867	68868
68869	68870	68871	68872	68873
68874	68875	68876	68877	68878
68879	68880	68881	68882	68883
68884	68885	68886	68887	68888
68889	68890	68891	68892	68893
68894	68895	68896	68897	68898
68899	68900	68901	68902	68903
68904	68905	68906	68907	68908
68909	68910	68911	68912	68913
68914	68915	68916	68917	68918
68919	68920	68921	68922	68923
68924	68925	68926	68927	68928
68929	68930	68931	68932	68933
68934	68935	68936	68937	68938
68939	68940	68941	68942	68943
68944	68945	68946	68947	68948
68949	68950	68951	68952	68953
68954	68955	68956	68957	68958
68959	68960	68961	68962	68963
68964	68965	68966	68967	68968
68969	68970	68971	68972	68973
68974	68975	68976	68977	68978
68979	68980	68981	68982	68983
68984	68985	68986	68987	68988
68989	68990	68991	68992	68993
68994	68995	68996	68997	68998
68999	69000	69001	69002	69003
69004	69005	69006	69007	69008
69009	69010	69011	69012	69013
69014	69015	69016	69017	69018
69019	69020	69021	69022	69023
69024	69025	69026	69027	69028
69029	69030	69031	69032	69033
69034	69035	69036	69037	69038
69039	69040	69041	69042	69043
69044	69045	69046	69047	69048
69049	69050	69051	69052	69053
69054	69055	69056	69057	69058
69059	69060	69061	69062	69063
69064	69065	69066	69067	69068
69069	69070	69071	69072	69073
69074	69075	69076	69077	69078
69079	69080	69081	69082	69083
69084	69085	69086	69087	69088
69089	69090	69091	69092	69093
69094	69095	69096	69097	69098
69099	69100</			